

[72] Inventor **John O. Yeiser**
Santa Ana, Calif.
 [21] Appl. No. **863,930**
 [22] Filed **Oct. 6, 1969**
 [45] Patented **Feb. 23, 1971**
 [73] Assignees **Yeiser Laboratories Inc., Costa Mesa, Calif., Enaed Electronics, Inc., Half Moon Bay, Calif., and Deane Electronics, Newport Beach, Calif., a fractional part interest to each**

2,016,709	10/1935	Eichenauer	101/93
2,039,791	5/1936	Furmay	101/93
2,399,724	5/1946	Dilling	101/93
2,566,972	9/1951	Wheeler	101/93
2,818,017	12/1957	Toggenburger	101/46
3,371,601	3/1968	Lane	101/93

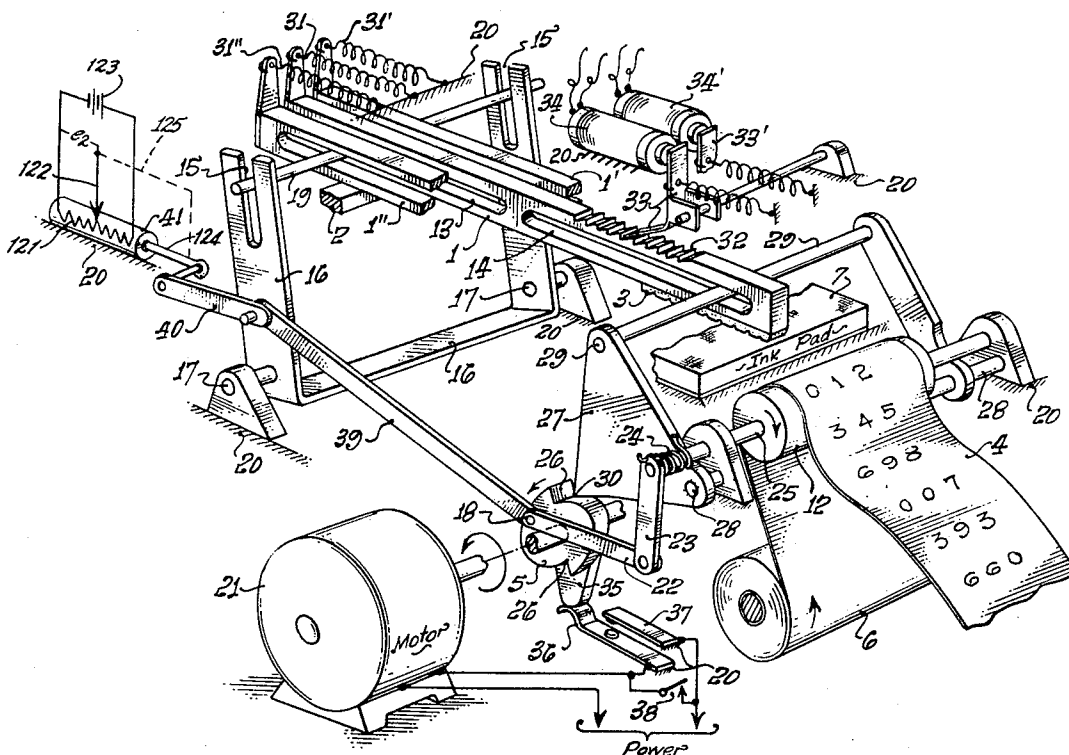
Primary Examiner—William B. Penn
 Attorney—Lawrence Fleming

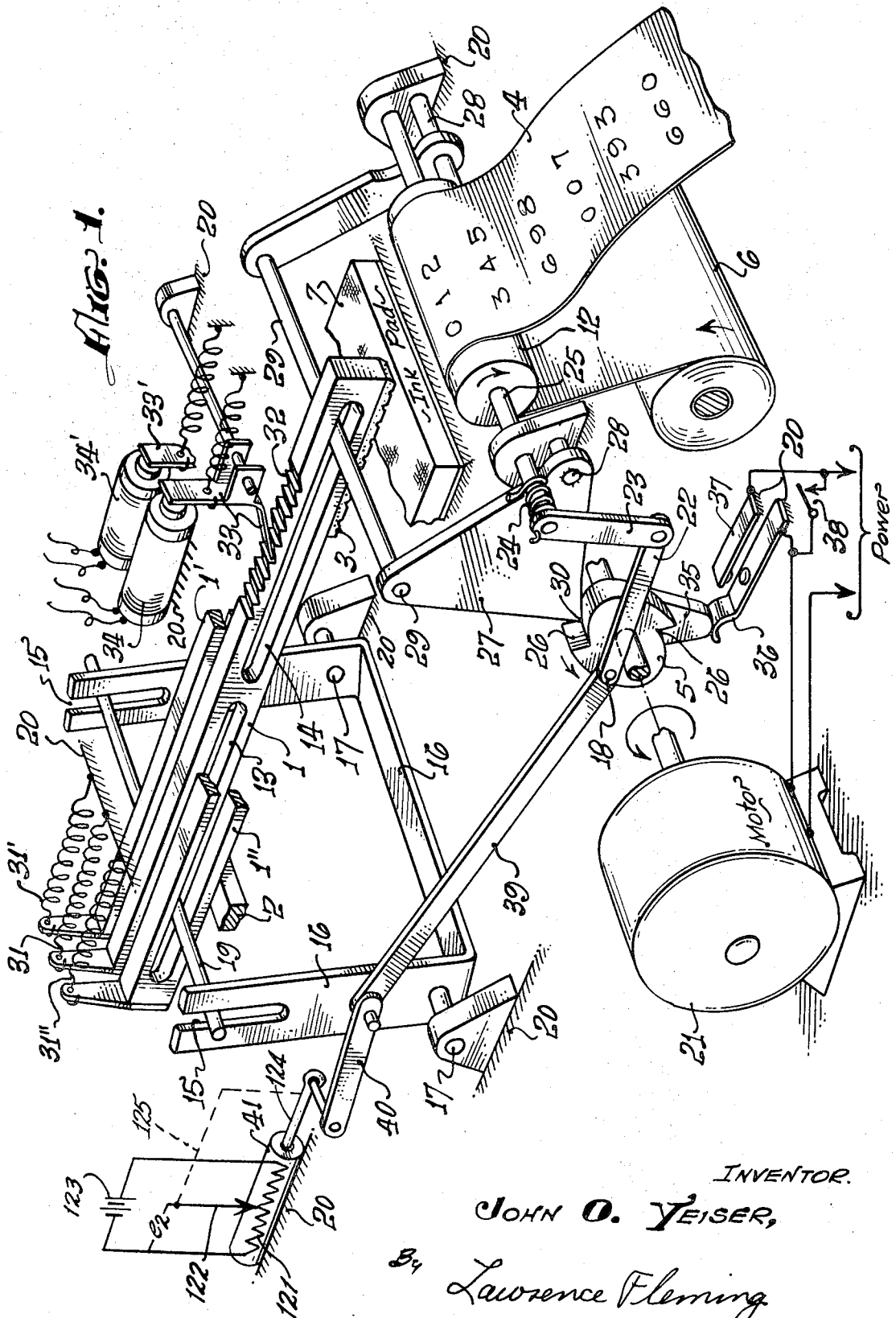
[54] **ELECTRICALLY CONTROLLED PRINTING MACHINE EMPLOYING RECIPROCABLE TYPE BIAS**
 10 Claims, 7 Drawing Figs.

[52] U.S. Cl. **101/93**
 [51] Int. Cl. **B41j 1/08, B41j 5/30**
 [50] Field of Search. **101/93, 109, 46, 94, 97, 98, 96, 202; 197/50, 51, 1**

[56] **References Cited**
UNITED STATES PATENTS
 1,333,890 3/1920 Wright 101/93
 1,768,526 6/1930 Lasker 101/93
 1,863,098 6/1932 Borel 101/93
 1,997,167 4/1935 Bryce 101/93

ABSTRACT: This device prints numbers or other characters on paper or other such material in response to digital electrical input signals. It uses linear type bars which are moved back and forth via a motor and springs, and are individually stopped at the correct characters by electrical or electromagnetic stop elements. These stops or latches are actuated via electrical comparators, which compare the electrical input signal for each type bar, typically in binary-coded-decimal code, with the electrical output of a position sensor, and stop each type bar at the proper position. Only one position sensor is needed for a plurality of type bars. A cam mechanism, in conjunction with springs, moves and raises and lowers the type bars. The type is first inked, and then the bars are moved forward and pressed onto the paper tape or other such material. This printer is particularly suited for connection to digital electrical indicating instruments, such as digital voltmeters. It is substantially simpler and cheaper to manufacture than other printers in this category.





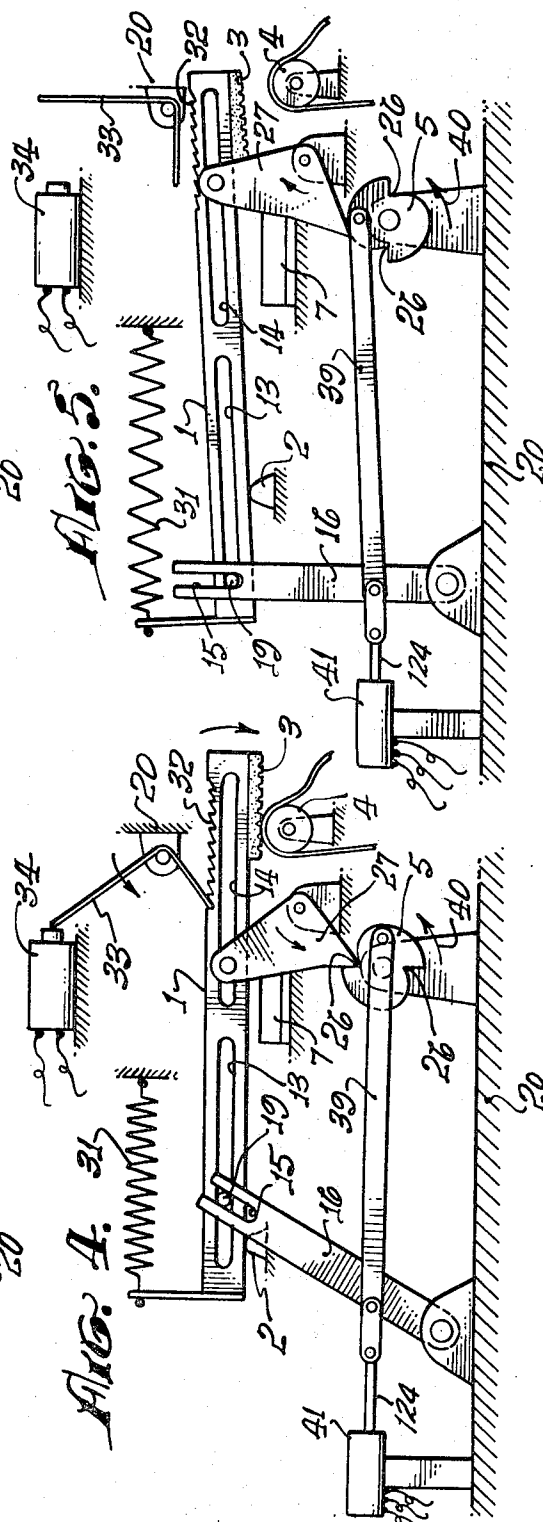
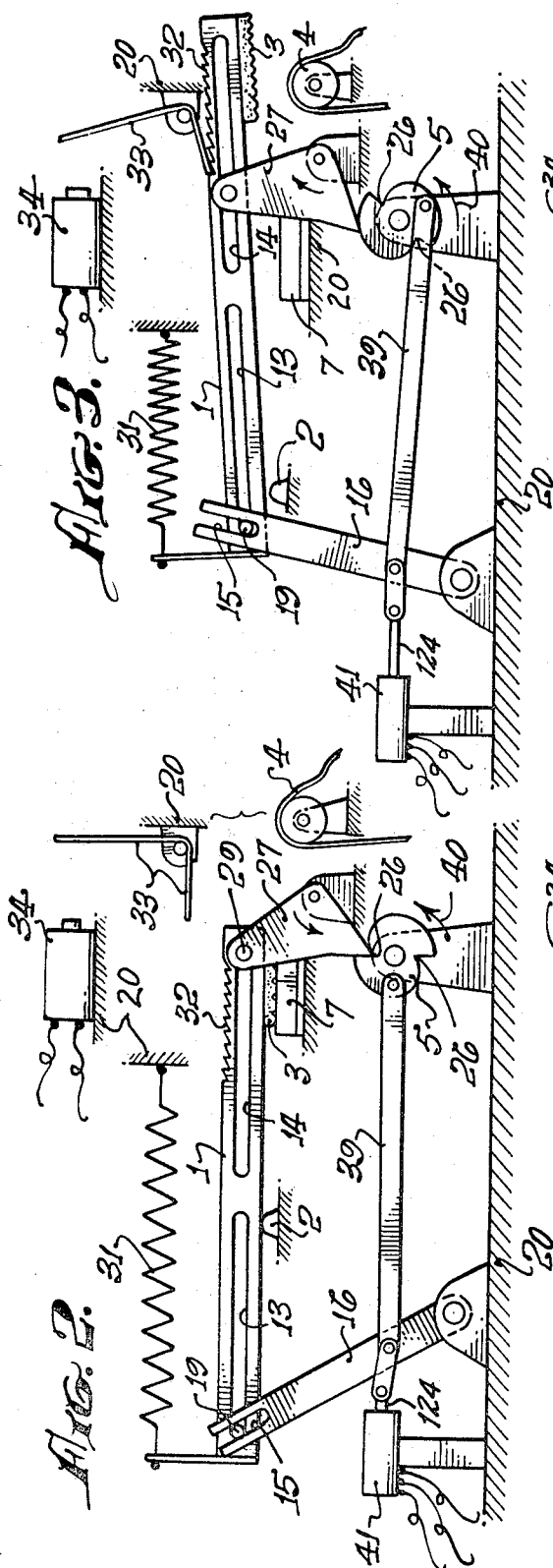
INVENTOR.

JOHN O. YEISER,

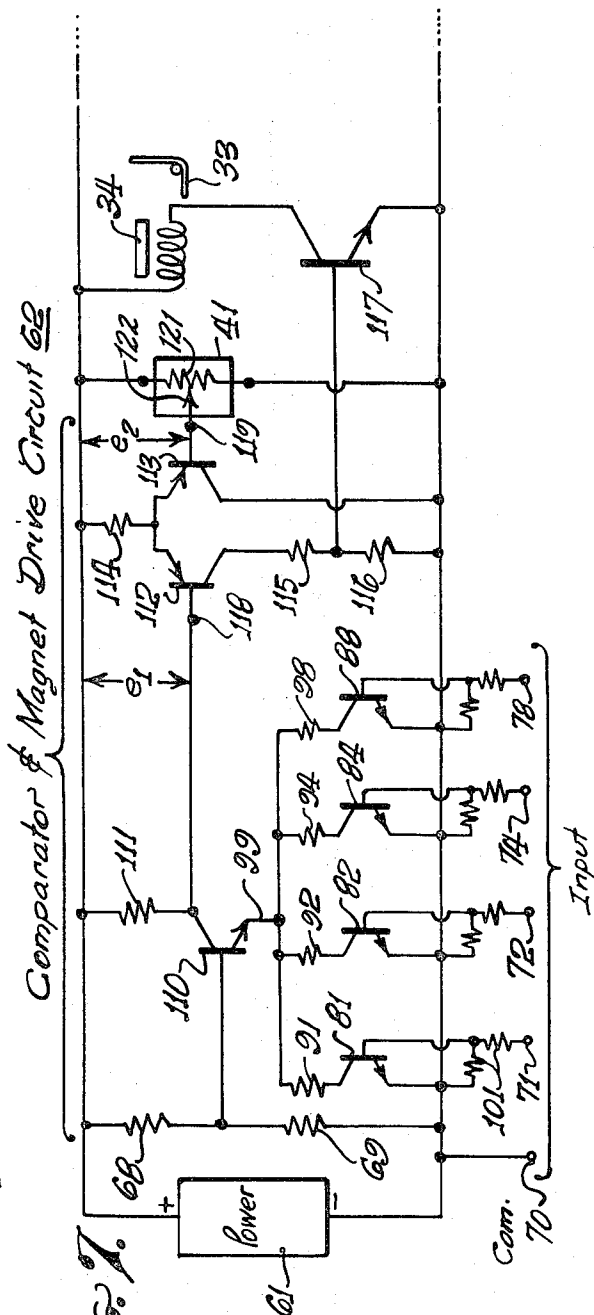
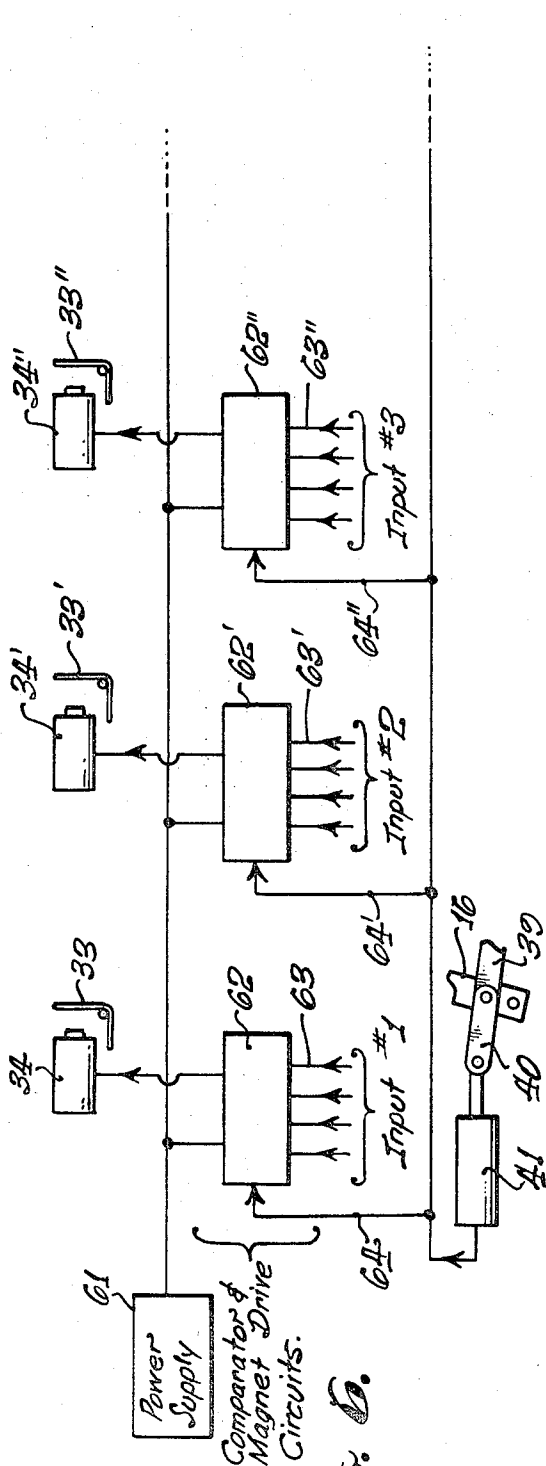
By

Lawrence Fleming

AGENT.



JOHN O. YEISER,
By Lawrence Fleming
INVENTOR.
AGENT.



INVENTOR.
JOHN O. YEISER,

By Lawrence Fleming

AGENT

ELECTRICALLY CONTROLLED PRINTING MACHINE EMPLOYING RECIPROCABLE TYPE BIAS

BACKGROUND OF THE INVENTION

This invention relates to printing machines which print numbers or other characters on paper tape or the like, in response to digital electrical signals applied to input terminals. A major application of the invention is in electrical attachment to digital electrical measuring instruments, such as digital voltmeters, to print out the data which these instruments indicate to the eye. A purpose of the invention is to provide such a printer that is cheap and simple of manufacture, compared to the relatively complex printers of the prior art.

Printers of the category in which this invention fits are of the following general nature: One or more movable type-carrying elements, such as type bars or type wheels, are provided, with means to sense their positions. During the "print" portion of the operating cycle, these elements are moved in a quasi-continuous manner via a motor, clutches, springs, or other suitable mechanical elements. When each of these elements arrives at the correct position to print the character determined by the electrical input signal, it is stopped and locked or latched into position. When all these elements are so locked, they are pressed against the paper, as a group, to print the input information.

In such printers, when the characters are arabic numerals, the electrical input signals are commonly in parallel binary-coded-decimal form, using either the well-known 1-2-2-4 or the 1-2-4-8 codes. For each type-carrying element there will be, in this common case, four input terminals (plus a common terminal).

These terminals are connected to comparators or coincidence detectors. Also, position sensors, such as decoding commutators, are provided to sense the position of each type-carrying element, and the outputs of these position sensors go also to the comparators or coincidence detectors. When the position of a type-carrying element corresponds to its digital electrical input signal, the comparator or coincidence detector will produce an output. This detector output is arranged to energize a stop or locking device, to latch the type-carrying element in the correct position. In this art, the position sensors may be either mechanical or electrical.

SUMMARY OF THE INVENTION

The printer of this invention employs type bars, each having a row of type, usually the arabic numerals 0-9 plus a space and some punctuation, near one end. Several identical bars, such as 4 to 10 bars, are typically used. The whole group of bars is swept or drawn back simultaneously, away from the paper roller, by a yoke-and-pin mechanism. Then the bars are permitted to move forward, each urged along by an individual spring. Each bar is stopped and locked at the correct position by an individual electromagnetic latch mechanism. When all the type bars are latched, the whole group of bars is pressed against the paper by a cam mechanism.

The latches are energized by electronic converter and comparator circuits. In these circuits, the parallel binary-coded-decimal (BCD) input signal corresponding to each type bar may be converted to an analogue voltage. This voltage may then be compared electrically with a second analogue voltage which represents the position of the type bar. This second analogue voltage may be derived from a single position sensor (such as an ordinary potentiometer) which is linked mechanically to the yoke mechanism, common to all the type bars. This is considered a cheap, novel, and reliable way to sense the positions of all the bars in succession. Its operation will be described in detail below.

In the remainder of the mechanical structure, a motor drives a cam wheel. Links from this wheel move the yoke, and also advance the paper. A cam follower on the cam raises and lowers the type bars twice in each operating cycle. They are raised during the times that they must move back and forth, and are lowered twice during a cycle: once for inking, and again for pressing against the paper.

SHORT DESCRIPTION OF DRAWINGS

FIG. 1 is a semidiagrammatic, partially cutaway, perspective view of the essential parts of the mechanism of the invention;

FIGS. 2, 3, 4, and 5 are side views of the major mechanical parts of the invention in connection with one type bar, showing four stages in its operating cycle, to illustrate its operation;

FIG. 6 is a block schematic diagram of the main portions of the electronic circuitry used in conjunction with the mechanisms of the invention; and

FIG. 7 is a schematic diagram of the electronic circuitry which may be used in conjunction with one of the type bars in the mechanism of the invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows the mechanical working parts of the invention in a semidiagrammatic, partially cutaway view, and will be described first. This is a preferred form of the invention, but is not considered limiting. In FIG. 1, the frame is omitted for clarity. Parts which are attached to the frame of the machine are indicated by "ground" symbol hatching, as at the various points designated 20 in FIG. 1.

A complete type bar is shown at 1. Two more identical such bars 1', 1'', are shown partially. More such bars may obviously be used, such as 4 or 6 or 10 of them.

These type bars may rest on a bar or guide 2, across which they all may slide. At the forward portion of a type bar such as 1, a row of type may be attached, as at 3 in FIG. 1, representing for example the arabic numerals 0 to 9, plus suitable punctuation marks and a space. This type may make marks on paper or other suitable film material 4, passing around a roller 12, and coming from a supply roll 6. To ink the type, an ink pad 7 is shown, against which the type 3 may be pressed before it is moved forward and pressed down on the paper 4. With various known varieties of ink, such as fluid stamp pad ink, no difficulties are experienced with ink buildup on the type faces.

The type bars 1, etc., have long slots 13 and 14. A pin 19 passes through all the slots 13. The ends of the pin 19 fit into the slotted ends 15, 15' of the yoke 16. Yoke 16 can rock back and forth on shafts 17. On moving back (toward the left in FIG. 1), it can collect all the type bars, via pin 19, and sweep or draw them to their rearmost position.

Yoke 16 is moved back and forth by a crank arm 39 which is driven from point 18 on a cam wheel 5. This cam wheel 5 is driven in rotation by a motor 21 (which motor is located inside the machine in practice, but is drawn here in an outboard location for clarity). When a "print" command is given the motor 21 turns cam wheel 5 through one revolution, then stops. The control apparatus that does this is conventional, and will be described later.

Also driven from point 18 on cam wheel 5 is a lever 23, via a crank arm 22, which advances the paper. This advancing is done by means of an overrunning clutch 24 which connects lever 23 to shaft 25; and shaft 25 turns the paper roller 12. The overrunning clutch 24 is illustrated as being of the coil spring type, but may be of any convenient known variety, such as a pawl and ratchet.

Thus, when motor 21 turns the cam wheel 5, crank arms driven therefrom at point 18 will rock the yoke 15 back and forth, and will also advance the paper via lever 23.

The cam wheel 5 has two identical depressed portions 26, located 180° apart. These operate to raise and lower the triangle-shaped cam follower 27. The stationary pivot point of this cam follower is at shaft 28. The upper corner of the cam follower 27 carries a pin 29, which passes through the forward slots 14 of all the type bars 1, 1', 1'', etc. The purpose of this pin 29 is to raise and lower the forward (type-carrying) ends of the type bars. When the corner 30 of cam 27 is down in a depressed portion or notch 26 of cam 5, the pin 29 pulls the type bars down. At one part of the operating cycle, it pulls them down against the ink pad 7. At another part of the cycle, it pulls them down against the paper 4 on roller 12, to print.

In between these events, the corner portion 30 of cam 27 rides upon higher portions of cam 5 and the type bars are accordingly raised up out of possible contact with either ink pad 7 or paper 4. In practice, the amount of vertical motion is small, of the order of 0.01 to 0.05 inch. While the type bars are thus raised up, their longitudinal motion, produced by yoke 16 or springs 31, takes place.

This brief discussion of the operating cycle of the printer of the invention is intended only to clarify the description of the structure. The operating cycle is described in detail in a later section of this specification, in connection with FIGS. 2—5.

Springs 31, 31', 31'', etc. are provided to move the type bars 1, 1', 1'', etc. forward individually during the appropriate portion of the operating cycle. The forward (right-hand, in FIG. 1) ends of these springs are anchored to an appropriate stationary point on the machine frame, as indicated at 20.

Each type bar 1, 1', 1'', etc. has a row of notches or teeth 32 along part of its length. These are spaced the same distance apart as the type characters in row 3. Disposed so as to engage with these notches or teeth 32 are latching elements 33. There is one for each type bar. When attracted by electromagnets 34, 34', etc., these latching elements will move so as to engage the notches or detents 32, and so lock the type bar with a selected type character opposite medium support or roller 12, in position to print said character on paper or medium 4. This is evident from FIGS. 1 and 3.

The motor 21, FIG. 1, is controlled in a conventional way. A cam 35, turning with cam wheel 5, engages a contact spring 36 once in each revolution, and separates this contact 36 from a stationary contact 37, opening the motor circuit. To start the operating cycle, a switch 38 is closed momentarily; and the motor 21 turns through one revolution and then stops itself by separating contacts 36, 37 via the cam 35.

The positions of type bars 1, 1', 1'', etc. may be sensed successively by means of a position sensor or transducer 41, FIG. 1, which may be for example an ordinary potentiometer, a differential transformer, or other known means. This sensor may be connected mechanically to sense the positions of the type bars through a link or rod 40 connected to yoke 16, whose position will at some time correspond to all the possible positions of all the type bars. Trigonometric errors may be corrected in any of the known ways, such as suitably tapering the curve of resistance ratio vs. position of the transducer 41, or by driving it by other known means, such as by pulleys and dial cable. It is noted that the accuracy required of sensor 41 is no more than a few percent of full scale. Other well-known position sensing means may be used, such as decoding commutators.

Sensor 41 in FIG. 1 is semidiagrammatically illustrated as a linear potentiometer of the type common in the art of electronic instrumentation. It may comprise a case (41), an operating rod or plunger 124, a linear resistance element 121, and a sliding contact or slider 122 making movable contact with resistance element 121. Slider 122 is mechanically connected internally of the case to the plunger 124, as indicated by dotted line 125, so that when plunger 124 is pushed in, slider 122 moves toward the left-hand end of resistance element 121; and when pulled out, it moves the point of contact toward the right-hand end of element 121. With a battery or other suitable source of voltage 123 connected in the conventional manner as shown, the output voltage e_2 of this potentiometer or sensor will increase as plunger 124 is pulled out, and decrease as it is pushed in. For a given voltage of source 123, the output voltage e_2 will have a different, known, value corresponding to every position of plunger 124. A voltage or signal such as e_2 , in this specification is termed a position signal. In the circuitry of FIG. 7, the sensor 41 is shown connected similarly, except that the voltage source, instead of source 123, is the common power supply 61. It is obvious that any suitable type of displacement transducer or position transducer known to the art of instrumentation could be used in place of a linear potentiometer at 41. Such as a linear variable differential transformer (LVDT) with appropriate circuitry;

or a rotary potentiometer or the like driven through a mechanical rack and pinion or a flexible cable or the like.

The exact function of the single transducer or sensor 41, in cooperation with the latching elements 33, 34, and with the control circuitry yet to be described (FIGS. 6 and 7) will be given in a later section in connection with FIGS. 2—7 of the drawing.

MODE OF OPERATION OF THE INVENTION

FIGS. 2, 3, 4, and 5 illustrate mechanically the four major stages in the operating cycle of the printer of the invention, in connection with one type bar 1 (for clarity). In FIG. 2, the cam wheel 5, revolving counterclockwise as indicated by arrow 40, has moved yoke 16 all the way back (to the left). Yoke 16 has swept or drawn type bar 1 all the way back, through pin 19 riding in slot 13. At this same time, cam follower 27 has gone down into a low spot or notch 26 in cam 5, moving the forward end of type bar 1 (via pin 29 in slot 14) down against the ink pad 7, to ink the type. Position sensor 41 is at its rearmost position.

FIG. 3 shows a second part of the operating cycle, mechanically. Here, the yoke 16 has moved forward (to the right) to the position where the type bar 1 is locked into position. The propulsive force to move type bar 1 forward is furnished entirely by spring 31; the yoke 16, in effect, holds it back. At this point, the electromagnet 34 has been energized in response to a signal from the comparator or coincidence detector (described later), and has moved the latch element or armature 33 so that it latches into one of the notches or teeth 32 on type bar 1.

As is known in the art, a comparator circuit receives two electrical input signals and produces an electrical output signal when the two inputs are substantially equal. This is explained fully in connection with FIGS. 6 and 7. In connection with FIG. 3, it is sufficient to note that one input signal to a comparator such as 62 (FIGS. 6—7) is derived from an external input signal representing the selected character to be printed, and the other from position sensor 41. When the plunger 124 of sensor 41 is in such a position that the selected character on a type row 3 is in line with paper roller or medium support 12, the two comparator inputs will agree; and the comparator will produce an electrical output, here termed a latching signal. This will act to operate the appropriate latching device 34, etc., to latch the type bar in place to print the selected character.

Type bar 1, at this point, has also been raised up, off the ink pad, by cam follower 27, so that it has been free to move longitudinally. The vertical motion is exaggerated for clarity of illustration; in practice it is typically of the order of 0.01 to 0.05 inch.

FIG. 4 shows the mechanical situation at a further stage in the cycle, where the bar, now latched into position at the correct character, is pressed down against the paper. The corner of the cam 27 has gone down into a notch or low spot 26 of the cam 5, and so lowered the selected type bar 1 so that one of the characters in row of type 3 (which row has been inked) is pressed against the paper 4, making a printout. Of particular significance is the fact that the latch 33 has stopped the type bar from moving (when it was urged forward by spring 31)—but that the pin 19, moved by yoke 16, continues forward as if nothing had happened. This is the purpose of the slot 13.

FIG. 5 shows the mechanism near the end of the operating cycle, where it is nearly back to the situation of FIG. 2. Cam 5 has raised follower 27 up, so that type 3 is up off of the paper 4. Arm 39, connected to cam wheel 5, is moving type bar 1 backward, against the pull of spring 31 (note that pin 19 is, necessarily, now against the back end of the slot 13). Electromagnet 34 has released the latch or armature 33, so that type bar 1 has been free to move longitudinally. The next stage will be like FIG. 2 again, where arm 39 has moved yoke 16 all the way to the back, and cam 5 has lowered the type bar, via cam follower 27, back down onto the ink pad 7.

It is to be noted that, wherever a latching device 34, 33 may stop a type bar during the forward portion of the cycle (FIGS. 3, 4), the pin 19 can continue to move freely to the end of its travel. The yoke 16, through pin 19, operates to draw or sweep the type bars back, but it does not force them forward. Instead, the pin 19 slides in the slots 13. The type bars are stopped by their individual latching devices 34, 33, in response to outputs from the control circuitry.

FIGS. 6 and 7 show the comparison and control circuitry. FIG. 6 is a block diagram of the circuitry for three type bars. More bars may obviously be used, with appropriate duplication of the circuitry blocks. In FIG. 6, three comparator circuit blocks 62, 62', 62'' are shown. Each has an output that energizes an individual magnetic latching device 34, 33, etc., to latch one type bar into the correct position. The circuit blocks are fed the necessary DC power from a common supply 61. Sets of input terminals 63, 63', 63'', etc., are provided for each of the circuit blocks. BCD or other types of parallel binary digital input signals, from external sources, are applied to these terminals. A position input signal from position sensor 41 (a function of the displacement or position of plunger 124) is fed commonly into position-input terminals 64, 64', 64'', etc., of all the circuit blocks 62, etc., at once.

In this system, FIG. 6, which uses only one position sensor 41, the operation of the circuit blocks may be explained by the following example: Assume that the coded digital signal at input 01 represents the arabic numeral 1, that the signal at input 02 represents numeral 9, and that the signal at input 03 represents numeral 4. Referring briefly back to FIGS. 2 and 3, the type bars (in this case, three of them) will move forward. When the output of position sensor 41 reaches a value corresponding to numeral 1, this fact will be recognized by whichever of the comparator circuits has a coded 1 applied to its input. That comparator will, through the associated energizing circuit, energize its corresponding latch. In this case, it will be comparator 62, FIG. 6. Those comparators whose inputs correspond to larger numbers are not yet ready to function; a 1 output from the position sensor 41 is of no immediate interest to a comparator that has, say a 4 input.

As the two remaining type bars continue to move forward, position sensor 41 gets to the point where it is delivering a 4 output. This matches input 03, to comparator 62'' which immediately energizes latch 33'' and stops that type bar at 4. The one remaining type bar continues forward until the sensor output matches the 9 signal at input 02. Then, the comparator 62' energizes latch 33' and stops that bar at 9.

Referring to FIG. 4, all three type bars are now latched in their correct respective positions, and the cam follower 27 presses the type against the paper 4, and prints 194. It is noted that in this system the type bars are latched in the order of the magnitude of the characters that they are to print, all during a single cycle of operation.

COMPARATOR CIRCUITRY

FIG. 7 is a schematic diagram of a preferred form of the circuitry which may be used in each of the blocks 62, 62', etc. of FIG. 6. Shown also in FIG. 7 are position sensor 41 and an electromagnetic latch 34, 33.

In FIG. 7, input terminals 70, 71, 72, 74, 78 are provided for the external input signal. In this example, the signal may be in the 1-2-4-8 BCD code. Conventional current-limiting and return resistors 101 may be associated with each input terminal (except common terminal 70). Input terminal 71 is connected, through such a resistor, to the control terminal of an active circuit device 81, in this case a transistor (although SCR's and other kinds of electronic switching devices may be used, or even relays). The signal voltage applied to terminal 71 is assumed to be large enough, e.g., 1 or a few volts, to make device 81 switch "on," as by saturating it if it is a transistor. Input terminal 72 goes similarly to a like device 82; terminals 74 and 78 to like devices 84 and 88.

Each of these active devices has a load resistor 91, 92, 94, 98, connected to a common point 99. The values of these resistors are chosen inversely to the relative magnitudes that they represent, i.e., 1, 2, 4, or 8. Point 99 is maintained at a substantially constant DC voltage with respect to common terminal 70, as by being connected to the emitter of a transistor 110, whose base is connected to the tap on a voltage divider 68, 69 across power supply 61. Load resistor 91 may for example be chosen so that when device 81 is saturated on "on," 1 milliampere flows through it. Similarly, load resistor 92 may be chosen to pass 2 milliamperes when its switch device 92 is "on"; and load resistors 94 and 98, to pass 4 and 8 milliamperes respectively. Only the resistance ratios matter; their absolute magnitudes are of minor importance. It will be seen that the circuitry so far described constitutes a BCD-to-analogue current converter. Thus, a BCD 5 input would constitute applying switching voltage to input terminals 71 and 74; and the current at summing point 99 would be an analogous 5 milliamperes.

The analogue current at point 99 is now converted into a proportionate voltage by means of active element 110, typically a transistor. Since its collector current is nearly equal to its base current—the current at point 99—the voltage drop across its collector load resistor 111 will be analogous. From the input terminals 71, etc., to the load resistor 111, the circuit is a BCD-to-analogue voltage converter.

The comparator circuitry including devices 112, 113 compares the analogue voltage drop across resistor 111 with the output of position transducer 41, and energizes the latch 34 when one exceeds the other. The analogue of the signal input e_1 is applied to a control terminal of active device 112, at point 118. The position sensor output e_2 is applied to a similar device 113, at point 119. Both devices may be transistors in the "long-tailed pair" type of circuit, with a common emitter load 114. The output of device 112 is coupled to an energizing circuit using a power transistor or other suitable switching device through conventional coupling resistors 115, 116. This electrical output at point 119 may be termed a latching signal. When the voltage e_2 becomes less than the voltage e_1 , device 112 will conduct, and switch the power device 117 "on," which will then energize the latch magnet 34 and stop the type bar.

It is not usually necessary to use a regulated power supply at 61, because the effect of supply variations on voltages e_1 and e_2 is similar.

After that part of the operating cycle where the printing takes place (FIG. 4), the yoke 16 moves back, and drives the plunger 124 of position sensor 41 back. During this return stroke, the sensor output will pass back through all the values that it had when the comparators 112, 113 (FIG. 7), and the energizing circuit, energized the latching magnets 34, etc. As it does so, each of the comparators will cause its associated power device such as 117, to cease conducting and release the corresponding latch magnet 34, etc. Thus, when the type bars are swept all the way back, all the latches 34, etc. have been released, and the printer is ready for another cycle.

I claim:

1. A printing machine comprising:

a plurality of bars each carrying a row of type and adapted to print a character selectively on a medium, a medium support;

each said bar being movable longitudinally between a starting position and a printing range of positions generally opposite said medium support;

sweep means to draw said bars collectively to said starting position;

spring means to draw said bars individually into said printing range;

latching means to latch each said bar at a selected position in said printing range with a selected character opposite said medium support;

press means to press said bars against said medium support to print said selected characters on said medium;

7

sensing means translating the longitudinal position of each said bar into an electrical position signal;
 a set of input terminals for each said bar to receive input signals representing said characters selectively;
 comparators connected to receive functions of both said input and position signals and each producing a latching signal when they agree;
 energizing means operating said latching means in response to said latching signal; and
 whereby said input signals select each of said selected characters to be printed by said press means.

2. A printing machine as in claim 1, further comprising:
 an ink pad;
 means synchronizing said press means with said sweep means; and
 said press means pressing each said row of type onto said ink pad when said bars are substantially in said starting position, and holding said bars out of contact with said pad between said starting position and said range of printing positions.

3. A printing machine as in claim 1, further comprising:
 an inking element;
 driving motor means;
 said sweep means comprising a swingable yoke and a reciprocating linkage connecting said yoke to said motor means, said yoke engaging a first pin which passes through first longitudinal slots in said bars; and
 said press means comprising an oscillatory mechanism connected to said motor means and to said bars, and adapted to press said type alternately against said inking element and said medium.

4. A printing machine as in claim 3, wherein:
 said oscillatory mechanism comprises a cam, a cam follower, and a second pin;
 said second pin passing through second longitudinal slots in said bars to impart motion to them substantially normal to their length.

5. A printing machine as in claim 1, further comprising:
 driving motor means connected to rotate a crank pin;
 a first cam, and a second cam;
 longitudinal slots in said bars, and slot pins passing slidably through said slots;
 said sweep means comprising a swingable pivoted yoke and a connecting rod connecting it to said crank pin;
 said yoke engaging one of said slot pins;
 said press means comprising a follower on said first cam connected to the other of said slot pins;

8

said second cam engaging electrical contacts connected to stop said motor means when said machine is substantially in said starting position; and
 manual switch means connected to said contacts to start said motor means to initiate an operating cycle.

6. A printing machine as in claim 5, wherein:
 said medium support is a roller supported in printing relation to said rows of type, and further comprises:
 an overrunning clutch connected to rotate said roller, and a crank linkage between said clutch and said motor means; and
 said linkage and clutch rotating said roller through a predetermined angle for each revolution of said crank pin.

7. A printing machine as in claim 1, wherein:
 said sensing means comprises a single mechanoelectric displacement transducer, and a driving linkage connecting the mechanical operating element of said transducer to said sweep means.

8. A printing machine as in claim 1, further comprising:
 an electronic digital-to-analogue converter connected between said input terminals and each said comparator and producing an analogue voltage function of each said input signal;
 said sensing means comprising an electrical analogue displacement transducer producing an analogue position signal; and
 said comparator being connected to receive said analogue voltage function and said analogue position signal.

9. A printing machine as in claim 8, wherein:
 each said converter comprises four electrical switching elements, each connected to a load resistor of weighted value;
 all said load resistors being connected to a current-summing junction;
 an electrical translating device connected to translate the sum of said currents into an analogous voltage; and
 said voltage constituting said analogue voltage function.

10. A printing machine as in claim 9, wherein:
 said switching elements and said translating device are transistors;
 said comparator comprises two transistors in a common-emitter differential connection; and
 said energizing means comprises a power transistor connected to receive a latching signal from a point in the collector circuit of said comparator.

50

55

60

65

70

75